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Competition and Quality in Health Care Markets. What Do We Know? What Don't We Know?

Martin Gaynor *

Summary

The goal of this paper is to identify key issues concerning the nature of competition in health care markets and its impacts on quality and social welfare and to identify pertinent findings from the theoretical and empirical literature on this topic. The theoretical literature in economics on competition and quality, the theoretical literature in health economics on this topic, and the empirical findings on competition and quality in health care markets are surveyed and their findings assessed.

Theory is clear that competition increases quality and improves welfare when prices are fixed (for prices above marginal cost). When firms set both price and quality the impacts on welfare are ambiguous. The body of empirical work in this area is small, but growing. It entirely consists of work on hospital markets. The empirical results are mixed across studies, although the bulk of the evidence shows that quality is higher in more competitive markets. It is clear that the impacts of competition on quality should

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be considered in antitrust matters in this industry. The evidence at this point does not overturn the antitrust presumption that competition is beneficial.

Keywords: competition, quality, health care, antitrust

J.E.L. : I11, L10, L4

1. Introduction

Cost control has emerged as a key issue for most developed countries' health systems. The development of most countries' health systems was initially guided by equity goals, [1] not efficiency. This led to common features such as universal coverage and no price rationing. However, health care spending has increased rapidly over time – the percent of GDP devoted to health care has more than doubled in the G7 countries since 1960. This has led to health system reforms aimed at combatting the increase in health care costs. In addition, quality problems have recently emerged as another area of concern.

Initially (1970s and 1980s), approaches to cost control were regulatory, e.g., fee reductions to health care providers and rationing access (especially to new technologies). These approaches did seem to slow the growth in costs, but only temporarily. As a consequence, continuing to contain costs would require continually tightening regulatory limits. Such an approach leads to the politically unattractive prospect of more visible and onerous rationing.

At present, market oriented approaches are being adopted or considered in a number of countries. [2] This has the attraction of reducing costs without public cuts in entitlements.

Once a market oriented approach is adopted, competition policy [3] becomes relevant. The presumption of competition policy regulations is that unregulated monopoly is bad, and further, that self-regulation (e.g., for professionals, like doctors) does not promote social welfare.

1. The U.S. may be an exception.
2. For example, the U.K., France, the Netherlands, Germany, Israel, Italy, Belgium, and Australia. This even includes the U.S., which already relies heavily on markets, if one considers policy discussions by the Bush administration which would lead to even greater use of markets than at present.
3. The term antitrust enforcement is used in the U.S. In what follows I will use the terms interchangeably. Since the paper is mainly focused on the U.S. experience, however, I will mainly use the term antitrust.

This is obviously relevant in the U.S. The U.S. relies on markets for health care delivery and financing. As a consequence, antitrust enforcement is an important component of health care policy. It is also increasingly relevant in the European context, as market based reforms are considered or adopted.

In Europe, most reforms involve competition in the supply of health care, while continuing central government financing. It is important to note that if supply is decentralized, then competition policy is relevant, even if financing is centralized. For example, as I will discuss later, even if price is set centrally, non-price aspects of service are determined by firms, thus competition and competition policy are relevant.

The U.S. is the country with the most experience with competition in health care markets. One of the most important industries in the United States economy is health care, accounting for over one trillion dollars in expenditure annually. This industry is also one in which competition is a real issue, given the extensive consolidation that has occurred in recent years (Gaynor and Haas-Wilson, 1999).

During the second half of the 1990s, a dramatic wave of hospital consolidation occurred in the United States. One source puts the total number of hospital mergers from 1994-2000 at over 900 deals (Jaklevic, 2002, and www.levinassociates.com), on a base of approximately 6,100 hospitals. Further, many local markets, including quite a few large cities such as Boston, Minneapolis, and San Francisco (and others), have come to be dominated by 2-3 large hospital systems. Not surprisingly, many health plans have complained about rising prices as a result of these consolidations (Lesser and Ginsburg, 2001).

Hospital markets have been an active area of antitrust enforcement. Since 1984, the federal antitrust authorities have brought 11 suits seeking to block hospital mergers, and engaged in many other activities combating anticompetitive practices. [4] The major emphasis in these cases has been effects on price. A major concern in health care, however, is effects on quality. [5]

Quality is of major concern in health care for a number of reasons. First, the effect of health care quality on an individual's well-being can be very great, and often will be more important than the quality of other goods or services. Second, due to the pervasive presence of insurance against health care expenditures, health care consumers are not exposed to the full expense associated with their health care decisions. Thus, in the presence of a reduced role for price, quality looms larger in consumer choice, and serves as an important rationing device. In the

4. See http://www.ftc.gov/ and http://www.usdoj.gov/ for detailed information.

5. Of course health care is not the only industry where effects on quality are important – it is, however, particularly salient here.

case of beneficiaries of the U.S. Medicare program [6], price is irrelevant for choice. Medicare pays hospitals and doctors fixed prices for their services, thus a Medicare beneficiary pays the same amount regardless of where she obtains service. Thus, for Medicare in particular, we would expect quality to be salient. [7]

This is not to say that price is not important. Most people with health insurance in the United States have some form of managed care insurance (Gabel et al., 2000). One of the defining features of managed care is restriction of consumer choice. Plan enrollees are allowed to choose from a pre-approved subset of doctors and hospitals in their area – not all doctors or hospitals. Managed care plans thus bargain with doctors and hospitals over prices. Hospitals or doctors with prices that are too high will be excluded. In principle, managed care plans are acting as agents for consumers. Consumers want to reduce the price of care, since higher prices result in higher premiums and lower consumption of other goods.

However, quality is obviously important as well as price. Indeed, many health care analysts have identified quality problems as a major failing of the U.S. health care system (Kohn et al., 1999; Institute of Medicine, 2001). Antitrust is important for health care quality, since health care quality is determined via markets. [8] The courts and the antitrust enforcement agencies have not dealt with quality in a uniform manner, however. In some antitrust cases, impacts on quality have been explicitly considered. In many cases, however, it has been simply presumed that price competition will lead to beneficial effects on quality. [9]

In this paper, I review the state of knowledge in economics on issues relevant to the assessment of the impact of competition in health care markets on quality. This is relevant for antitrust policy in the U.S., where there are well established health care markets, and for the evaluation of market oriented reform proposals in Europe and elsewhere. I limit myself to the economics literature, or papers published outside of traditional economics journals, but nonetheless using an economics approach. I do not survey the health services research literature on quality, in particular the literature on outcomes research. That literature is primarily concerned with measurement, as opposed to assessing the impact of competition. Romano (2003) provides an excellent review of this literature.

In what follows I first discuss the performance standard for competition in economics and antitrust, then review relevant findings from economic theory,

6. Mostly those over age 65, but also some disabled individuals, notably those with end-stage renal disease (kidney failure).

7. This will also be true for in many European health systems.

8. See Sage et al. (2003) for a discussion of the role of competition policy in determining health care quality.

9. See Hammer and Sage (2002) for a comprehensive review of the treatment of health care quality by the courts in antitrust cases.

then consider empirical evidence on health care competition and quality. The final section of the paper contains a summary and conclusions.

2. Performance Standards

In economics the performance standard is social welfare – consumer plus producer surplus. In antitrust, however, the standard against which performance is evaluated is consumer harm. As a consequence, antitrust neglects producer welfare and only considers the well-being of consumers. In what follows, I follow economics practice and consider social welfare as the performance standard, except where otherwise specified. As will become clear, in some cases considering only consumer welfare can lead to substantially different conclusions.

3. What Do We Know From Economic Theory ?

Economists, antitrust scholars, and the courts intuitively think that competition is a good thing. Indeed, this is the presumption of antitrust law. Economic theory when there are differentiated products, however, is not so clear. In what follows, I review the state of knowledge on this issue from economic theory. I divide my review into analyses where price is fixed versus those where price is free to vary. These assumptions lead to very different results.

In particular, the impact of competition is reasonably clear when prices are fixed. If price is above marginal cost, competition leads to quality being greater, and can lead to the socially optimal quality if price(s) is set at the right level. If firms choose both price and quality, however, the results are much less clear.

3.1. Models

The theory of competition with differentiated products is complicated. Product differentiation is represented in a number of different ways. My purpose here is not to review the literature, but to try and draw out key insights. As a consequence, I will use only simple presentations of the theory and not dwell on details. [10] It will be necessary to distinguish between models of vertical product differentiation (i.e.,

10. For more complete presentations and reviews, see Tirole (1988); Eaton and Lipsey (1989); Anderson et al. (1992)

product quality) and horizontal product differentiation (i.e., product variety) for clarity in reviewing results. I will gloss over the differences, however, in trying to draw out policy relevant conclusions about competition and social welfare with differentiated products. Table 1 presents a summary of the various papers and their findings.

3.2. Variable Prices

There is a very broad literature on product differentiation. I will review only the findings from a few key articles. Most research has found ambiguous effects of competition (or monopoly) on welfare. In what follows, I review the key findings for vertical differentiation first, then for horizontal differentiation.

Vertical Differentiation

First consider the model of vertical differentiation by Spence (1975). Here the question is whether a monopolist will produce the socially optimal level of quality (only one level of quality can be chosen). Let market inverse demand be $p = P(q, z)$, where p is price, q is quantity, and z is quality. Assume that price is decreasing in q and increasing in z. Let the cost function be $TC = C(q, z)$, where costs are increasing in quantity and quality.

First consider the choices made by a social planner, who maximizes social welfare (the difference between consumer surplus and cost),

$$\max_{q,z} W(q,z) = \int_0^q P(x,z)dx - C(q,z). \tag{1}$$

The first-order conditions to this problem are :

$$P(q,z) - \frac{\partial C(\cdot)}{\partial q} = 0 \tag{2}$$

$$\int_0^q \frac{\partial P(x,z)}{\partial z} dx - \frac{\partial C(\cdot)}{\partial z} = 0 \tag{3}$$

Now consider the monopolist's problem. The monopolist maximizes profits,

$$\max_{q,z} \pi = P(q,z) \cdot q - C(q,z) \tag{4}$$

The first-order conditions to the monopolist's problem are :

$$P(q,z) + q \cdot \frac{\partial P(\cdot)}{\partial q} - \frac{\partial C(\cdot)}{\partial q} = 0 \tag{5}$$

$$q \cdot \frac{\partial P(\cdot)}{\partial z} - \frac{\partial C(\cdot)}{\partial z} = 0 \tag{6}$$

A comparison between the first-order conditions (3) and (6) is illuminating. Dividing the first terms in both equations by q, we have the social planner concerned with the average marginal valuation of quality,

$$\left(\int_0^q \frac{\partial P(x,z)}{\partial z} dx \right) \Big/ q$$

whereas the monopolist is concerned with the "marginal marginal" valuation of quality, the marginal consumer's marginal valuation of quality,

$$\frac{\partial P(q,z)}{\partial z}$$

The social planner considers the effect of an increase in quality on all consumers, whereas the monopolist considers only the effect of an increase in quality on the marginal consumer. Therefore, for a fixed quantity, the monopolist will provide too little, the right amount, or too much quality as,

$$\left(\int_0^q \frac{\partial P(x,z)}{\partial z} dx \right) \Big/ q \gtreqless \frac{\partial P(q,z)}{\partial z}$$

The monopolist will supply the socially optimal quality only when the marginal consumer is the average consumer. When the marginal consumer's valuation is less than the average the monopolist will supply too little quality, and vice versa. Since it seems quite likely there is considerable heterogeneity in consumer preferences for health care quality, it seems particularly unlikely that the expression above is an equality.

The consequence is that there is no general theoretical prediction on whether monopoly reduces welfare when there is vertical product differentiation. The exception to this conclusion occurs if the monopolist can perfectly price discriminate. Under this condition the monopolist will maximize social welfare. Since the monopolist captures all of consumer surplus when they perfectly price discriminate their problem is the same as the social planner's problem in (1). Although this will lead to the socially efficient outcome, this is not optimal from the perspective of antitrust, since the discriminating monopolist captures all of the surplus.

It is possible to construct less general models that generate the conclusion that monopoly undersupplies or oversupplies quality.[11] Consider the following example from Pepall et al. (2005).

Let consumers have the following inverse demand function, $p = z(\theta - q)$. The term θz is the reservation price, so consumers' reservation price is increasing in quality. Let the costs of production be constant and zero, but the costs of quality be described by $c = \alpha z^2$. Then the first-order profit maximization conditions for the monopolist are :

$$\frac{\partial \pi}{\partial q} = z(\theta - 2q) = 0 \quad (7)$$

$$\frac{\partial \pi}{\partial z} = (\theta q - q) - 2\alpha z = 0 \quad (8)$$

We can solve for the monopolist's profit maximizing quantity and quality, which are $q_m = \frac{\theta}{2}$ and $z_m = \frac{\theta^2}{8\alpha}$.

The monopolist clearly does not choose the quantity and quality that maximize social welfare. Since the marginal cost of quantity is zero, the social welfare maximizing quantity is θ. That is the quantity at which the demand curve crosses the horizontal axis. We can find the social welfare maximizing quality as follows. Social welfare is maximized where the change in consumer surplus from additional quality equals the marginal cost of quality,

$$\int_0^q (\theta - x)dx = 2\alpha z \quad (9)$$

$$\theta q - \frac{q^2}{2} = 2\alpha z$$

Solving, we find that the social welfare maximizing quality is $\frac{\theta^2}{4\alpha}$.

This example precisely illustrates Spence's point. In this case, $\left(\int_0^q \frac{\partial P(x,z)}{\partial z} dx\right) \Big/ q = \theta - \frac{q}{2}$, and $\frac{\partial P(q,z)}{\partial z} = \theta - q$. So $\left(\int_0^q \frac{\partial P(x,z)}{\partial z} dx\right) \Big/ q > \frac{\partial P(q,z)}{\partial z}$, which means that the monopolist undersupplies quality.

Mussa and Rosen (1978) is an important paper with a different setup than Spence. In their paper, Mussa and Rosen consider vertical differentiation by a monopolist where the monopolist sells the same good at different levels of quality to discriminate among consumers with different valuations.[12] The monopolist

11. See Tirole (1988), Section 2.2.1 and Pepall et al. (2005), Section 7.5.1, for examples.

12. In Spence's model only one level of quality can be chosen. This drives the difference between Spence and Mussa and Rosen.

cannot perfectly price discriminate – it does not know individuals' valuations. The monopolist does know, however, the distribution of valuations in the population. As a consequence, the monopolist can set quality levels to get consumers to self-select their most preferred quality, thus allowing the monopolist to price discriminate. This leads to a distortion, thus monopoly leads to inefficient quality choice.

Consider a simple example with two types of consumers. Let type 1s value quality more than type 2s. The monopolist can maximize profits by setting two levels of quality in such a way that the type 1s select the high quality good and the type 2s select the low quality good.

In order to do this, the difference in quality between the high and low quality products has to be large enough that the type 1s will not choose the low quality good. The self-selection then allows the monopolist to set the prices of the high and low quality good to extract the maximum amount of surplus from consumers.

This, however, leads to a distortion. In order to get the type 1s to choose the high quality/high price product, the monopolist sets the quality on the low quality product low enough that it is not a good substitute to the type 1s. Thus quality choice is distorted.

As in all models of this type, the inefficiency results from an information asymmetry. If the monopolist knew consumers' valuations, then it could perfectly price discriminate. This would be socially efficient, although not desirable from an antitrust perspective.

Some further insight into the determinants of quality levels by can be gained from the model of Dorfman and Steiner (1954). Their model is nominally about choice of price and advertising, but can also be interpreted as about price and quality (although in a somewhat restrictive way). [13] Consider a firm who has the following profit function, where per unit (and marginal) costs are constant in quantity (q) and increasing in quality (z), [14]

$$\pi = q(p, z) \cdot (p - c - d \cdot z) - F \tag{10}$$

The first-order conditions with respect to price and quality are,

13. Dorfman and Steiner model a monopolist's behavior. We can consider this an approximation to the behavior of a monopolistically competitive firm if we think of the demand function as a reduced form demand, e.g., an oligopolist's residual demand curve (see, e.g., Dranove and Satterthwaite, 2000).

14. This is a modification of the cost structure used by Dorfman and Steiner.

$$\frac{\partial \pi}{\partial p} = q + p \cdot \frac{\partial q}{\partial p} - c - d \cdot z = 0 \quad (11)$$

$$\frac{\partial \pi}{\partial z} = p \cdot \frac{\partial q}{\partial z} - d \cdot q = 0 \quad (12)$$

Let the price and quality elasticities of demand be,

$$\varepsilon_p \equiv -\frac{\partial q}{\partial p}\frac{p}{q} \quad (13)$$

$$\varepsilon_z \equiv \frac{\partial q}{\partial z}\frac{z}{q} \quad (14)$$

Then the first-order condition for price can be expressed in the following familiar form (remembering that marginal cost = $c + d \cdot z$),

$$p = \frac{c + d \cdot z}{1 - \frac{1}{\varepsilon_p}} \quad (15)$$

or as the Lerner Index,

$$L = \frac{p - (c + d \cdot z)}{p} = \frac{1}{\varepsilon_p} \quad (16)$$

After some manipulation we can obtain the following formula, known as the Dorfman-Steiner condition,

$$\frac{d \cdot z}{p} = \frac{\varepsilon_z}{\varepsilon_p} \quad (17)$$

or

$$z = \frac{p}{d} \cdot \frac{\varepsilon_z}{\varepsilon_p} \quad (18)$$

This says that the amount spent on quality relative to sales should go up if the quality elasticity of demand increases or the price elasticity of demand declines, and vice versa. It also offers some other insights.

Presume that there exist "optimal" values of the price and quality elasticities, that is, there exist unique values which induce the monopolist to choose the socially optimal price and quality. Then if market power over price increases, i.e., ε_p goes down, price will increase above the optimum. Quality will also increase,

but to a supra-optimal level. [15] Alternatively, if the quality elasticity decreases, quality will fall to a sub-optimal level, even if the price elasticity is at its optimal value. If an increase in market power reduces both the price and quality elasticities, the effect on quality is unclear. Price will certainly rise. If the price and quality elasticities fall by the same proportion, so that their ratio is unchanged, price will still rise and as a consequence quality will also rise above its optimal level. If the ratio of the quality elasticity to the price elasticity falls by more than price increases, quality will fall below the optimal level.

While there are still no determinate conclusions from this framework, it does offer some useful guidance for thinking about issues of competition in health care markets. For example, the advent of managed care in the 1990s is commonly thought to have increased the price elasticity of demand facing health care firms (hospitals in particular). This should have led to decreased prices, and indeed seems to have done so. [16] If there was no sufficiently countervailing increase in the quality elasticity, then quality should have fallen. It is important to bear in mind here that if the starting point was one where hospitals possessed market power, then the model predicts that quality should have been at supra-optimal levels. Thus a decrease in quality could be welfare improving (assuming it did not fall below the optimal level).

Another change in health care markets is the recent emphasis on medical errors and quality improvement. If that leads to the quality elasticity of demand increasing, then quality will increase. If the price elasticity remains unchanged this will increase price (since the increase in quality increased marginal cost), but price cost margins will remain unchanged. This framework will prove helpful in making sense of some results from the empirical literature, as we shall see later in this paper.

Horizontal Differentiation

In the previous section I reviewed the findings of economic theory on quality and competition for models of vertical product differentiation. I now turn to horizontal differentiation. The classic references on this are Dixit and Stiglitz (1977) and Spence (1976).

To illustrate, consider a simple model based on Spence (1976) and Mankiw and Whinston (1986). Let consumer preferences be represented by :

15. The excess profits may attract entry, but that entry is not necessarily welfare increasing. Each entrant adds F to costs, but does not necessarily increase surplus accordingly. See the next section for an explicit discussion of this issue.

16. See Dranove and Satterthwaite (2000) and Gaynor and Vogt (2000) for reviews of the evidence.

$$u = G\left(\sum_{i=1}^{\infty} f(q_i)\right) \tag{19}$$

where firm i produces output q_i and both of the functions G and f are concave. This gives consumers a taste for product variety and also implies that the various firms' products are substitutes.

Costs consist of a fixed cost of entry, K, and variable cost, $c(q)$.

Impose symmetry for simplicity and let the social planner choose product variety (i.e., the number of firms, N). With N firms the symmetric firm output is q_N.

$$\max_N \; W(N) = G(N \cdot f(q_N)) - N \cdot c(q_N) - N \cdot K \tag{20}$$

Now consider profit maximizing behavior by firms. First note that with N firms, utility maximization by consumers implies that the equilibrium price is $G'(N \cdot f(q_N))f'(q_N)$. Each firm's equilibrium profits are therefore,

$$\pi_N = G'(N \cdot f(q_N))f'(q_N) \cdot q_N - c(q_N) - K \tag{21}$$

Now consider the first-order condition for the social planner,

$$W' = G'[Nf'q'_N] - c(q_N) - Nc'(q_N)q'_N - K \tag{22}$$

We obtain the following expression by adding and subtracting the term $G'f'q'_N$ and rearranging.

$$W' = \pi_N + N[G'f' - c']q'_N + G'[f - f'q_N] \tag{23}$$

First, assume that the third term in the expression above is zero. Now consider the second term. $G'f' - c'$ is price minus marginal cost. It is non-negative. The term q'_N is how per firm output changes with the number of firms. Assume it is negative, i.e. there is a business stealing effect of firm entry. Then, for any markup of price over marginal cost, the second term is negative. Thus $W' < \pi_N$. This implies that π_N at the socially optimal N is positive. At a competitive (free entry) equilibrium, profits must equal zero. It is true that profits fall with the number of firms (see Mankiw and Whinston). This then implies that the number of firms in competitive equilibrium is greater than the socially optimal number, i.e. competition produces too much product diversity. This happens because firms don't take the business stealing effect into account. The gain in social welfare from entry is outweighed by the fixed costs incurred. The conclusion is different, however, when measured

against an antitrust performance standard of consumer welfare. Ignoring the fixed costs incurred by entering firms, since they don't affect consumer welfare, implies that consumers are made (weakly) better off by entry. [17]

Now assume that the second term in (23) is zero and consider only the third term. $G'[f - f'q_N]$ represents the effect of product diversity (due to more firms). This term is positive, since f is concave. Consumers value product diversity, but an entering firm cannot capture all of the increase in surplus they generate. $G'f$ is the contribution to surplus of another firm, and $G'f'q_N$ is the firm's revenue. Using the argument from the preceding paragraph, the fact that this term is positive implies that a free entry equilibrium will produce too little product diversity, due to the non-appropriability of social surplus.

It isn't possible in general to tell whether one of these terms is larger than the other. The business stealing effect could dominate the non-appropriability effect, or vice versa, or they could be exactly balanced. Therefore a free entry monopolistically competitive equilibrium can result in too much product diversity, too little, or precisely the optimal amount.

3.3. Fixed Prices

In contrast to the mostly ambiguous theoretical results on competition and quality with variable prices, the theoretical literature on competition and quality when prices are fixed is quite clear. When price is above marginal cost, competition leads to more quality and it is generally excessive. In what follows I review the general economics literature on this topic and also that from health economics.

A common reason for prices to be fixed is government regulation. The most prominent example of this in health care is the Medicare program. Medicare sets fixed prices for hospitals based on a patient's diagnosis. Doctors are paid fixed prices for services provided. Further, Medicare benefits are such that Medicare beneficiaries pay the same amount regardless of the provider they use to obtain care. As a consequence, economic models of competition with fixed prices are relevant here.

These models largely derive from analyses of industries subject to price regulation up until the 1970s and 1980s, e.g., airlines and taxis. [18] There are also some models specific to health care. [19] The intuition of these models is as follows.

17. If there is 100% business stealing then consumer welfare is unaffected. If there is less than 100% business stealing, then consumers are made better off.

18. See, for example, Douglas and Miller (1974); Schmalensee (1977); Vander Weide and Zalkind (1981); White (1972) on airlines and Frankena and Pautler (1984) on taxicabs.

19. Allen and Gertler (1991); Held and Pauly (1983); Pope (1989).

Price is regulated, so firms compete for consumers on non-price dimensions, i.e. "quality." If the regulated price is set above marginal cost at some baseline level of quality, then firms will increase quality to try to gain market share. This will continue until profits are zero. Since firms don't take account of stealing market share, in equilibrium quality levels will be excessive.

Consider the following sketch of a simple model. Let quality have only a vertical dimension, i.e., "more is better." For simplicity in exposition, assume that the demand that any firm i faces is separable in its market share, s_i, and the level of market demand,D. Firm i thus faces a demand of :

$$q_i = s_i(z_i, \mathbf{z_{-i}})D(\overline{p}, z_i, \mathbf{z_{-i}}) \tag{24}$$

where s_i is firm i's market share, z_i is firm i's quality, $\mathbf{z_{-i}}$ is a vector of all other firms' qualities, D is market demand, and $\overline{p}$ is the regulated price. [20] Assume that i's market share is increasing in own quality, decreasing in the number of firms, and that the responsiveness of market share to own quality is also increasing in the number of firms.

Assume that firms all use the same technology and face the same input prices. Then they each have costs described by :

$$c_i = c(q_i, z_i) \tag{25}$$

Further assume that there is free entry and exit, so that all firms earn zero profits in equilibrium. Then, assuming Nash behavior, equilibrium is described by the solutions to the following across all firms i :

$$\begin{aligned} \frac{\partial \pi_i}{\partial z_i} &= [\overline{p} - \frac{\partial c_i}{\partial q_i}]\left\{\frac{\partial s_i}{\partial z_i}D(\cdot) + s_i\frac{\partial D(\cdot)}{\partial z_i}\right\} \\ &\quad -\frac{\partial c_i}{\partial z_i} = 0 \end{aligned} \tag{26}$$

and

$$\pi_i = \overline{p} \cdot q_i - c_i = 0 \tag{27}$$

Inspection of (26) yields some immediate insights. First compare equilibrium quality under monopoly to that with multiple firms. Notice that, since a monopolist faces market demand, the first term in curly brackets in (26) vanishes and

20. Note that for consumers insulated from the cost of consumption, as in health care, the price they face will be less than the price received by the firm. I ignore this in order to keep this sketch of a model simple. It would not affect the conclusions in any event.

$s_i = 1$. Since $\frac{\partial s_i}{\partial z_i}$ is positive (by assumption), the term in curly brackets is larger with multiple firms than with a monopolist, so equilibrium quality is higher with competition. Whether welfare is higher depends on the relative magnitudes of $\frac{\partial s_i}{\partial z_i}$ and $\frac{\partial D}{\partial z_i}$. In particular, if $\frac{\partial D}{\partial z_i}$ equals zero, then increases in quality do not shift market demand (i.e., they do not benefit consumers), and quality competition is simply over market share, and hence wasteful.

Since $\frac{\partial s_i}{\partial z_i}$ increases with the number of firms (i.e., the firm's demand becomes more elastic with respect to own quality the more alternatives there are for consumers), quality competition will be more intense with entry and equilibrium quality will increase with the number of firms in the market. As indicated immediately above, this may result in excessive quality levels.

The positive predictions of this model are clear. Quality is increasing in the number of firms in the market, i.e., competition leads to more quality. Further, quality is increasing in the regulated price. One may write down a firm's equilibrium quality function as the (implicit) solution to equations (26) and (27),

$$z^e = z(\overline{p}, c_q, c_z, s_i, D) \tag{28}$$

where c_q and c_z denote first derivatives. The firm's level of quality depends on the price cost margin, the marginal cost of quality, the level of demand, market share, the quality elasticities of market share and market demand.

This has implications for econometric specifications for empirical analysis. The equation to be estimated is (28). However, measures of marginal cost, market share, and demand are likely to be endogenous in an econometric equation. One would employ exogenous determinants of these factors, such as cost shifters (W), demand shifters (X_D), and the number of firms (N). An econometric specification would thus look something like the following,

$$z^e = z(\overline{p}, W, X_D, N) \tag{29}$$

As we shall see, most of the empirical studies to date include a measure of market structure and a number of control variables. They are not generally clear about whether the control variables represent cost shifters or demand shifters. Further, the regulated price, $\overline{p}$, is generally omitted from empirical studies, although theory indicates its inclusion.

The normative implications of the model are less clear than the positive ones. Depending on the nature of demand (specifically how responsive market demand is to quality), competition may lead to excessive quality provision. Similarly, a higher regulated price may reduce welfare by leading to excessive quality. These

conclusions, however, are altered if we consider only consumer welfare. Consumers are never made worse off by competition. If competition leads only to demand stealing they are no better off as a result, but if it leads to any increase in market demand then consumers are unequivocally better off.

The model outlined above is not specific to health care. In particular, the majority of firms in the hospital industry are not-for-profit. Let us now write down a simple model that captures this aspect of the health care industry. There have been many models of not-for-profit hospitals (Pauly and Redisch, 1973; Newhouse, 1970; Lee, 1971; Lakdawalla and Philipson, 1998). While there is no agreement on a general model, most models posit an objective function which includes profits and some other argument, such as quantity or quality. Therefore, let us assume that not-for-profit hospitals have an objective function which includes quality and profits (as a shorthand for everything else they care about). Further, for simplicity, let this function be additively separable in quality and profits and linear in profits :

$$U_i = u(z_i, \pi_i) = v(z_i) + \pi_i. \tag{30}$$

We can now revisit the first-order conditions for quality choice (26), modified to take account of this objective function :

$$\begin{aligned} \frac{\partial U_i}{\partial z_i} &= [\overline{p} - \frac{\partial c_i}{\partial q_i}] \left\{ \frac{\partial s_i}{\partial z_i} D(\cdot) + s_i \frac{\partial D(\cdot)}{\partial z_i} \right\} \\ &\quad - \frac{\partial c_i}{\partial z_i} + \frac{\partial v}{\partial z_i} = 0 \end{aligned} \tag{31}$$

Notice that the only difference with the first-order conditions for an industry of profit maximizing firms is the presence of the last term, $\frac{\partial v}{\partial z_i}$. Since this term is positive, the value that not-for-profit firms put on quality acts like a reduction in the marginal cost of producing quality, i.e., not-for-profit firms will act like for-profit firms with a lower marginal cost of quality. [21] This implies that quality will be higher in equilibrium. The comparative statics, however, are identical with an industry of profit maximizing firms. Quality is increasing in the number of firms and the regulated price, as before. [22]

21. This is the same specification and result as for not-for-profit firms that care about quantity, as opposed to quality. See Lakdawalla and Philipson (1998); Gaynor and Vogt (2003).

22. It should be noted that this result might not obtain with a more general objective function, in particular, if utility is concave in profits, i.e., firms are risk averse (see Eggleston et al., 2003, for a model like this).

4. What Do We Know From Econometric Studies ?

There is a relatively small, but rapidly growing empirical literature on competition and quality in health care. At present the evidence from this literature is entirely on hospital markets. In what follows I will review this literature, focusing mainly on the economics literature. [23] I will first review the results from econometric studies of markets with fixed prices, and then variable prices, reversing the ordering of the preceding theory section. I do this because the theoretical predictions for markets with fixed prices are clearer, thus they offer a clearer target for econometric hypothesis testing.

The studies reviewed here employ a variety of econometric approaches. Probably the modal approach is what I will call a "Structure-Conduct-Performance" (SCP) specification. These econometric models are derived from a conceptual model that hypothesizes a causal link from market structure to firm conduct and then to industry performance. [24] Most SCP models at present focus on the link between market structure and firm conduct, and omit industry performance. The typical conduct measure in the general industrial organization literature is price or price-cost margin. The typical measure of market structure is the Herfindahl-Hirschmann Index (HHI), which is the sum of the squares of all firms' market shares. [25] The equation usually estimated has roughly the following appearance,

$$p = \beta_0 + \beta_1 q + \beta_2 X_D + \beta_3 W + \beta_4 HHI + \varepsilon \tag{32}$$

where X_D represents demand shifters and W captures cost shifters. The SCP studies of quality simply employ a measure of quality as the dependent variable in this equation, rather than price. Only one of the studies I review estimated equations for price and quality together.

The SCP approach has a number of well recognized problems when price is the dependent variable (see Bresnahan, 1989; Schmalensee, 1989, on these issues). These problems also apply when quality is the dependent variable, and there are some additional issues. First, the use of HHI in a pricing equation can be explicitly derived only from a homogeneous goods Cournot model of conduct. [26] Obviously

23. Not too surprisingly, this captures the vast majority of such studies, given the nature of the topic. While I believe I have captured most of the prominent work on this topic, I do not claim to have covered every study, however, in particular any that may have appeared in the medical literature.

24. See Carlton and Perloff (2005).

25. I.e, HHI = $\sum_{i=1}^{N} s_i^2$, where s_i is firm i's market share, and there are N firms in the market.

26. In that case, the coefficient on the HHI in an SCP regression captures the elasticity of demand, not firm conduct (which is already assumed to be Cournot).

an SCP regression with quality as the dependent variable does not derive from this framework. In the case of fixed price, theory does point to an econometric model with a measure of market structure on the right hand side (see equation (29)). Even in this case, or if one thinks of a quality SCP regression as deriving from a broad conceptual framework as opposed to a specific theoretical model, a number of issues remain. The HHI is usually regarded as endogenous. Factors that affect firms' choices of quality also may affect their market shares or affect entry. In addition, unmeasured variation in demand and cost factors affect both quality and market structure. For example, a firm with low costs is likely to have both a high market share (leading to a high HHI) and choose high quality (refer to equation (18) for optimal quality in the Dorfman and Steiner type framework).

Two additional specification issues arises in regard to SCP studies of markets with fixed prices. With a variable price model it is clear that price and quality are determined simultaneously, so an SCP model might either include price and treat it as endogenous, or simply include exogenous determinants of price. Typically price is not included in the studies reviewed here, although it is not clear whether the authors were explicitly trying to include exogenous determinants of price. When price is fixed, however, price (or the price cost margin) should appear as an exogenous determinant of quality (again, see equation (29)).

Further, there is an additional complication due to the nature of hospitals. The major purchasers of hospital services are Medicare and private health insurers. Medicare sets, fixed, regulated, prices. Prices from private health insurers are variable. Since hospitals generally sell in both markets, one must either account for this or presume that there are no complementarities between the two (e.g., demand and cost are completely separable in Medicare and private output). Many of the studies that focus on Medicare seemingly make the implicit assumption of separability.

While the majority of the studies I review here employ an SCP framework, some employ different approaches. Some studies evaluate the impact of mergers, some evaluate the impact of regulatory changes (e.g, price deregulation), one study estimates a structural model of demand, one study examines the determinants of the number of firms, and a number estimate the relationship between hospital volume of a surgical procedure and patient health outcomes. Each of these approaches have their advantages and disadvantages. I will discuss these in the context of evaluating the various studies.

Before proceeding, however, I want to note that the results of the majority of these studies provide evidence only on positive questions, e.g., "Does competition increase quality ?". Few of these studies allow for normative analysis. This first wave of studies consists for the most part of policy evaluation and reduced form

studies.[27] It is not possible to evaluate effects on welfare with these kinds of studies. This should not be taken as a criticism of these studies, but simply a recognition of what sorts of inferences can be drawn from them.

4.1. Studies with Fixed Prices

There are a number of studies of hospital quality provided to Medicare patients. I call these studies with fixed prices, since the amount a Medicare beneficiary pays is the same, regardless of where she obtains care. As a consequence, price is not a strategic variable for hospitals serving Medicare patients. Table 2 presents a summary of these studies and their findings. The entry in the column labelled "Results" indicates the direction of the relationship between the competition measure and the quality measure. For example, in the first row, a + in that column indicates that a higher value of the HHI resulted in higher mortality in that study.

Kessler and McClellan (2000) is a study of the impact of hospital market concentration on risk-adjusted one year mortality from acute myocardial infarction (AMI, i.e., a heart attack) for Medicare patients. Expenditures on these patients are also studied. The study included data on all non-rural Medicare beneficiaries with AMI during selected years from 1985 to 1994. Kessler and McClellan use the SCP framework discussed above, with some modifications. They instrument for the HHI with hospital market shares predicted from a model of patient choice of hospital, where patient choice is largely determined by distance from the hospital. They also employ zip code fixed effects. As a consequence, the effects of hospital market concentration are identified by changes in the predicted HHI. The specification they employ, however, does omit the regulated Medicare price. A number of hospital and area characteristics are included, HMO enrollment among them. It is unclear whether they are considered demand or cost shifters.

The results from this study are striking. Kessler and McClellan find that risk-adjusted one year mortality for Medicare AMI patients is significantly higher in more concentrated markets. In particular, patients in the most concentrated markets had mortality probabilities 1.46 points higher than those in the least concentrated markets (this constitutes a 4.4 percent difference) as of 1991. This is an extremely large difference – it amounts to over 2,000 fewer (statistical) deaths in the least concentrated vs. most concentrated markets. The results with regard to expenditures have a somewhat different pattern. Prior to 1991, expenditures were higher in less concentrated markets, while the reverse is true as of 1991.

27. By policy evaluation studies, I mean econometric specifications that evaluate the impact of some policy or (economic) environmental factor, but are not derived from an explicit economic model. By reduced form, I mean an econometric specification that is the reduced form of a specific economic model.

Kessler and McClellan also find that HMO enrollment reduced expenditures on average, but had no statistically detectable impact on mortality. They also find an interaction effect between HMO enrollment and market concentration. In low HMO enrollment states, patients in less concentrated markets had higher expenditures and better (although statistically insignificant) outcomes. In states with high HMO enrollment, patients in less concentrated markets had lower expenditures and lower mortality.

The positive inferences from this study are very clear. Mortality from heart attacks for Medicare patients is lower in less concentrated markets. The effects of concentration are stronger beginning in 1991 and are reinforced by HMO enrollment. The omission of the regulated price is unfortunate, although for bias to result the changes in price would have to be correlated with the within zip code changes in the predicted HHI. It is unclear whether the inclusion of market and hospital characteristics is intended to control for possible hospital complementarities between Medicare and private output. So long as it is unlikely there are important omitted factors there should be no problem with bias. While it is clear that concentration affects hospital quality, the mechanism by which this works is not.

It seems unlikely that hospitals deliberately choose lower quality in the form of an increased probability of death. What may be happening is that hospitals in more concentrated markets take some of their excess profits in slack. General slack in the hospital may have the unintended consequence of higher mortality. Another issue with regard to this application is whether hospitals compete for heart attack patients. Tay (2003) states that one-half of heart attack patients arrive at the hospital via ambulance. It seems unlikely that these patients have any choice of hospital, hence hospitals cannot compete for these patients. I think the most likely story is that heart attack patients are the "canary in the mine shaft." Hospitals in more competitive environments are pressured to be better across the board, and that manifests itself clearly in a very sensitive area – heart attack patient mortality.

While the basic positive results from this study are clear, I don't believe that there are clear normative inferences. Kessler and McClellan claim that the results that show that both expenditures and mortality are lower in less concentrated markets show that there is a welfare gain from competition. I do not believe this is so. First, the measure of Medicare expenditures they use is not a measure of economic cost. Second, and more fundamentally, economic theory does not predict that quality competition in price regulated markets will lead to optimal quality levels. If price is above marginal cost at the optimal quality then competition will lead to excessive quality, and vice versa. Therefore, the finding that quality is higher in less concentrated markets does not tell us anything about welfare. We need to be able to distinguish whether price is above or below marginal cost at the

optimal quality. This is a formidable task for any analysis, but in particular it is a question which an SCP analysis is not designed to answer. Quality in unconcentrated markets could be too high, too low, or just right. The model that Kessler and McClellan employ ably identifies the relation between concentration and quality, but does not allow for the evaluation of welfare effects.

Gowrisankaran and Town (2003) estimate the effects of hospital market concentration on risk-adjusted mortality rates for AMI and pneumonia, for both Medicare and HMO patients. I will discuss their findings with regard to Medicare patients here, since the price is fixed, and discuss the findings with respect to HMO patients in the next section. Gowrisankaran and Town use data from Los Angeles county from 1991-1993 for AMI and 1989-1992 for pneumonia. Their approach is similar to that of Kessler and McClellan. They use an SCP framework, instrumenting for the HHI with hospital market shares predicted from a patient choice equation, where distance is the main determinant of hospital choice. An innovation is that they construct separate, hospital-specific, HHIs based on (predicted) hospital market shares for Medicare, HMO, Medicaid, indigent and self-pay patients, and indemnity patients.

Gowrisankaran and Town find, in contrast to Kessler and McClellan, that mortality is worse for Medicare patients treated in hospitals with lower Medicare HHIs. The implication is that competition reduces quality for Medicare patients. Gowrisankaran and Town hypothesize that Medicare margins are small or negative, or that hospitals may deviate from profit-maximizing behavior. If Medicare margins are indeed negative (i.e., $p < MC$), then the results are consistent with theory.

This study also omits Medicare price. It includes some hospital characteristics, although it is unclear if these characteristics are considered demand or cost shifters. It would be very useful to be able to examine the impact of Medicare price on hospital quality.

It is hard to know why the results of this study contrast so markedly with the previous one. It may be that the Medicare price is below marginal cost (on average) for the hospitals in Gowrisankaran and Town's study, while the opposite is true for the hospitals in Kessler and McClellan's study. This is only speculation, however. The opposite results from the two studies suggest caution in drawing strong conclusions about the impact of market structure on hospital mortality at this point.

A recent paper by Tay (2003) takes a more structural approach. Tay specifies and estimates a structural econometric model of hospital choice by Medicare enrollees with AMI. Tay uses data on urban enrollees in conventional Medicare, located in California, Oregon, and Washington in 1994. She examines the effect of a number of aspects of quality and distance on the probability a patient is admitted to a particular hospital. The quality measures include two clinical out-

comes : the mortality rate and the complication rate ; a measure of input intensity : nurses per bed ; and whether the hospital can perform two high-tech cardiac services : catheterization or revascularization. All measures of quality are treated as exogenous.

Tay finds that hospital demand is negatively affected by patient distance and positively affected by quality. She then simulates the effects of changes in the various aspects of a hospital's quality, holding the total number of heart attack patients fixed, the locations of patients and hospitals fixed, and the qualities of all other hospitals fixed. Adopting a catheterization lab is predicted to increase demand by 65 percent, while adding revascularization in addition to catheterization increases demand by 76 percent. If the number of nurses per bed is increased by one percent, then demand is predicted to increase by 24 percent.

Tay shows that hospital demand is significantly affected by quality and distance, thus there are potentially high payoffs to hospitals increasing quality. While this represents an advance over the previous literature by using more detailed modelling, there are nonetheless some limitations to the inferences that can be drawn from this study.

As with the previous studies, the Medicare price is omitted. It is possible that this omission is inconsequential, but I see no way to tell. Tay assumes that hospitals set the same level of quality for Medicare and non-Medicare patients. This is also an untested assumption, although it is at least explicit.

More fundamentally, the supply side of the market is not modelled. As a consequence, competition itself is not modelled and can not be examined explicitly. There is no structure in place for dealing with the potential endogeneity of the quality variables. There is the usual reason to be concerned about endogeneity, since quality is chosen by the firm. In addition, it has been observed for a number of hospital procedures that hospital volume causes patient outcomes (see section 4.2 below for a review of some studies). This suggests endogeneity of the mortality and complication rates. Further, the simulation is only of unilateral actions. It is not a simulation of equilibrium. As a consequence it is hard to assess the magnitude of quality effects. Last, as Tay acknowledges, without a supply side no welfare analysis can be performed.

Most of these studies are quite recent. There are, however, two early studies that should be mentioned. Shortell and Hughes (1988) examine the association between in-hospital mortality among Medicare patients in 1983 and concentration. They find no statistically significant association, and the point estimate of the impact of concentration on mortality is small. Shortell and Hughes also examine the impact of stringency of state hospital price regulation programs and state regulation of hospital entry. They find that mortality was significantly worse in states with stringent price regulation and strict entry restrictions. This is exactly

as the theory predicts – if the regulated price is lower, quality will be lower as well. Entry restriction will lead to lower quality.

Held and Pauly (1983) examines the competition and quality in the dialysis market. All people with end stage renal disease (ESRD, i.e., kidney failure) in the U.S. are covered by Medicare. Medicare pays a fixed price to dialysis facilities for treating patients. They use data on dialysis facilities in large urban areas of the U.S. in 1977 and 1978. The measure of quality is dialysis machines per patient. The notion is that greater capacity translates into greater convenience for patients in scheduling appointments. They regress the HHI for dialysis facilities on the number of dialysis machines per patient, including a number of control variables. The Medicare price is omitted, because there is no variation in the price in the sample. Held and Pauly find that there are more dialysis machines per patient in less concentrated areas. Hence, competition increases quality. Held and Pauly recognize that they are unable to draw normative conclusions from their analysis.

4.2. Studies with Prices Free

I now turn my attention to econometric studies of competition and quality where prices are free to vary. I will subdivide these studies into three categories. The first consists of older studies of the "Medical Arms Race." The second are newer studies that examine the impact of competition on hospital quality either via the SCP model or examining the impacts of mergers or price deregulation. The last category are papers studying the relationship of hospital volume of specific procedures to patients' clinical outcomes. The results are summarized in Table 3. In some cases, the quality measure is something like service provision, which is positively associated with quality, so that a – sign in the "Results" column indicates that quality was higher in less concentrated markets. In other cases, the quality measure is mortality, which is negatively associated with quality, so that a + sign in the "Results" column also means that quality is higher in less concentrated markets.

Older Studies – "Medical Arms Race"

There are a number of studies of what has been dubbed "The Medical Arms Race." These studies examine the impact of competition on a number of measures of quality, usually facilities rather than clinical quality. They cover the period in the 1970s and 1980s when it was generally agreed that price competition among hospitals was weak or nonexistent. The notion was that, since price competition was weak, then competition must occur over non-price attributes. If we accept that price competition during this period is essentially nonexistent, then these

studies should be regarded as essentially studies of competition with fixed prices, in contrast to the more recent studies I discuss below, which occur during a period in which there is clearly vigorous price competition.

This literature typically regresses a measure of market concentration (often the HHI) on some measure of input use or costs. The medical arms race is to be detected via a negative correlation between concentration and the input measure. Evidence of a negative relationship is generally presumed to be evidence of welfare reducing non-price competition.

Examples of this literature are Joskow (1980); Robinson and Luft (1985); Dranove et al. (1992). Joskow examines the relationship between hospital reserve capacity (i.e., unoccupied beds) and the HHI for all U.S. hospitals in 1976. He finds that hospitals in less concentrated markets had more excess capacity. Based on the model of quality competition with fixed prices presented in Section 3.3, Joskow deduces that competition may lead to supra-optimal excess capacity in hospital markets. This may be correct, but unlike the model, prices are not fixed. Without a fuller examination of price determination in hospital markets at that time it isn't possible to make a determination about the welfare impacts of non-price competition.

Robinson and Luft (1985) study the impact of market structure on inpatient admissions, outpatient visits, length of stay and average costs for California hospitals in 1972. They use indicators of the number of other hospitals within a 15 mile radius of a hospital as measures of market structure, and regress those on their outcome variables. Robinson and Luft find that hospitals with more neighbors within 15 miles have more inpatient admissions and higher costs per case and per day, although there is no impact on outpatient visits or length of stay. They infer that hospital competition is welfare reducing. Although the correlations this study turned up are interesting, it is not clear how to interpret them, either positively or normatively. The relationships they estimate are not derived from any obvious economic model, which makes interpretation difficult.

Dranove et al. (1992) examine hospital adoption of sophisticated medical technologies. They utilize 1983 hospital data from California, and examine the impact of the HHI and market size on the number of hospitals in the market adopting particular technologies. Dranove et al. find that the HHI has a negative impact on the number of hospitals adopting these technologies, i.e., there is more adoption in less concentrated markets. They also find, however, a very strong effect of market size on adoption. They interpret their results as providing evidence that market size is more important than market concentration, although the results do provide at least weak support for the medical arms race hypothesis.

Noether (1988) uses a slightly different methodology. She uses data on prices and expenses for 11 frequent diagnoses in all U.S. hospitals located in SMSAs from

1977 and 1978. She finds that less concentrated markets have lower prices and higher expenses, although the effect is weak and small. Thus this paper provides some moderate support for the existence of both price and non-price competition among hospitals in the 1970s.

Recent Studies

There have been a number of more recent studies of competition and quality in hospital markets. These all cover time periods from the 1990s or later, when it is generally agreed that price competition had emerged in hospital markets. I will first discuss SCP studies, then cover merger studies, then finally move to studies of price deregulation. In considering these studies we need to refer back to the theory for guidance. Unlike the case of fixed prices, economic theory on competition and quality is less clear. Nonetheless, theory does provide a guide to what to look for, and what economic factors might be underlying an estimated relationship.

The study by Gowrisankaran and Town (2003) examined the relationship between market structure and AMI and pneumonia mortality in Los Angeles county in the early 1990s for both Medicare and HMO patients. I discussed the findings for Medicare patients in the previous section. I now turn to HMO patients. Gowrisankaran and Town find that risk-adjusted mortality is significantly lower in less concentrated parts of Los Angeles county. This implies that competition is quality increasing for HMO patients. Using equation (18) for guidance, we see that this could occur if the quality elasticity of demand is higher in less concentrated markets, or if the price elasticity is lower. Since we generally think that elasticities are higher with more competitors, the former seems plausible (and the latter does not).

Sohn and Rathouz (2003) study the impact of competition on risk-adjusted mortality for patients receiving percutaneous transluminal coronary angioplasty (PTCA) in 116 hospitals in California in 1995. They construct a "competition coefficient" that varies between zero and one depending on the degree of overlap in the patient pools of a pair of hospitals. Sohn and Rathouz find that mortality is lower for patients in hospitals facing more competition. This effect is stronger in lower volume hospitals. Again, this result seems to imply that the quality elasticity is higher in more competitive markets.

Propper et al. (2004) use an SCP approach to examine the effect of the effect of hospital competition in the United Kingdom following reforms to the National Health Service in the 1990s. These reforms encouraged payer-driven competition among hospitals. Propper et al. examine the impact of this payer-driven competition on mortality for AMI patients. They examine the impact of a measure of market structure (roughly, the number of competitors) on mortality over the per-

iod 1995-1998 and find that mortality increases with the number of competitors. This finding certainly contrasts with that of U.S. SCP studies, but (for better or for worse) it is consistent with theory. The presence of more competitors can increase quality elasticity, price elasticity, or both. If the price elasticity increases more than the quality elasticity, then quality will fall. Whether this is the mechanism driving the result in this paper can't be determined, although it provides some direction for future research. As previously, the welfare impacts of this finding are unclear. If increasing the number of competitors is associated with a decrease in market power, then a quality decrease may be welfare improving. Alternatively, it could be harmful.

An interesting recent study is by Sari (2002). Rather than following the common practice of using risk-adjusted mortality as a quality measure, Sari employs a newly available set of quality indicators developed by the Agency for Health Care Research and Quality (AHRQ). These indicators measure a variety of factors reflecting clinical quality, including mortality, obstetric complications, adverse or iatrogenic complications, wound infections, surgery complications, caesarean section, and inappropriate surgery. [28] He employs data on hospitals in 16 states covering the period 1992-1997 and estimates the SCP model using fixed effects, random effects, and instrumental variables with fixed effects. Sari finds that quality is significantly lower in more concentrated markets – he estimates that a 10 percent increase in hospital market share leads to a 0.18 percent decrease in quality. He also finds evidence that managed care penetration increases quality for some of the quality indicators, although there is no statistically significant relationship for others.

Ho and Hamilton (2000) and Huckman (2002) are two papers that examine the impact of hospital mergers on quality of care. Ho and Hamilton (2000) study 130 hospital mergers of various types over the period 1992 to 1995. The quality measures they employ are inpatient mortality, readmission rates, and early discharge of newborns. They employ hospital specific fixed effects to control for time invariant hospital characteristics that may be related to merger. Ho and Hamilton find no detectable impact of merger on mortality for either heart attack or stroke patients. They do find that some mergers increase readmission rates for heart attack patients and the early discharge of newborns. It is unclear whether Ho and Hamilton find no effect because there truly is no effect or because they are unable to identify the effect in the data. The effects of mergers are notoriously difficult to identify. Mergers occur for reasons that are often related to the outcome variables of interest.

Huckman (2002) examines hospital acquisitions in New York state over the period 1992 to 1999, where the acquiring hospital provided PTCA or CABG and

28. Go to http://www.qualityindicators.ahrq.gov for more information.

the acquired hospital did not. There were 28 such acquisitions. He finds that risk adjusted mortality was lower as a result of these acquisitions. The mechanism for this is unclear. It may be that patients in the acquired hospitals now benefit from the provision of these new services. Alternatively, it may be that the newly combined hospitals now produce a higher volume of these procedures, resulting in better outcomes. A third possibility is that the acquired hospitals were poorly managed relative to their potential for quality, and the acquisition improved this.

Two very interesting recent papers use changes in regulation as a way to learn about the effect of hospital competition on quality. Volpp et al. (2003) study the effect the deregulation of hospital prices in New Jersey to try and learn about the impact of the introduction of price competition on hospital quality. In 1992 New Jersey deregulated hospital prices. The neighboring state of New York had no change in its hospital regulatory regime. Volpp et al. use data on AMI hospital admissions in New Jersey and New York from 1990 to 1996 to learn about the effect of the deregulation. They look at the difference in risk-adjusted inpatient AMI mortality between New Jersey and New York before and after regulatory repeal. They find that mortality in New Jersey relative to New York increased after price deregulation. At first glance this result contrasts markedly with the SCP type studies previously discussed. However, consider the impact of price deregulation. The biggest impact should be to increase the price elasticity of demand, and decrease price. [29] The quality elasticity seems unlikely to be significantly affected. The prediction of the Dorfman and Steiner type model is that quality will fall when the price elasticity of demand increases. It is impossible to say what the impact on welfare might be. If the regulated prices were set too high, then this quality decrease is welfare increasing, and vice versa.

A paper by Propper et al. (2003) employs a similar approach to Volpp et al.. In this paper Propper et al. (2003) examine the impacts of competitive reforms in the NHS on mortality for AMI patients. Propper et al. (2003) use a different strategy in this paper than in Propper et al. (2004). Here they use the change in regulation in the U.K. over the period 1991-1999, combined with geographic variation in the number of competitors. [30] Competition was introduced in 1991 and actively promoted up until 1995. It was downplayed after 1995 and actively discouraged from 1997 onwards. The impact of competition is identified by differences between hospitals facing competitors and those who are not between the time periods when competition was encouraged versus when it was discouraged.

Propper et al. (2003) find that competition reduces quality. The differences in mortality for hospitals in areas with competitors versus those with no competitors was higher during the period when competition was promoted (1991-1995), than

29. Unfortunately Volpp et al. do not have any evidence on the effect of deregulation on prices.
30. In Propper et al. (2004) only variation in the number of competitors was used.

during the period when competition was discouraged (1996-1998). The estimated cumulative effect of competition over the entire period is to raise mortality rates by roughly the same amount as the cumulative effect of the secular downward trend in heart attack mortality (presumably due to technological change). As with Volpp et al. (2003), these results can be interpreted as consistent with the Dorfman and Steiner model, although that is not testable within the framework employed in the paper. Also as before, the welfare inferences are unclear.

Abraham et al. (2003) is one of the few studies with clear welfare implications. Abraham et al. examine the determinants of the number of hospitals in isolated markets in the U.S. for 1990. They do not examine price or quality explicitly. Instead, they infer whether competition is increasing by the population required to support another firm in the market. If the population required to support another firm is increasing, then average profits available post-entry must be decreasing, thus increasing the volume necessary to make entry profitable. They find that market size is the primary determinant of the number of hospitals, and that the quantity bought and sold in the market rises, and variable profits fall, as the number of hospitals in a local market increases. This implies that the market is getting more competitive as the number of hospitals increase. Further, it shows that entry isn't simply demand-stealing – more hospitals increase demand. The reason is that quantity demanded can increase only if price is lower or quality is higher. Since that does happen, people are consuming more and must be better off. As a consequence, they conclude that competition increases with the number of hospitals, and that competition is welfare improving.

Studies of the Volume-Outcome Relationship

There have been a very large number of studies of the "volume-outcome" relationship, the majority in the medical literature. These studies commonly find a significant correlation with the volume a hospital does of a procedure and the medical outcomes of patients receiving the procedure at that hospital. The obvious concern with studies of this kind is endogeneity. It may be that hospitals that do more of a procedure are better at it, whether from learning by doing or by making quality improving investments. It may also be true, however, that patients are attracted to hospitals with the best outcomes. The studies in the medical literature are unable to distinguish between these two alternatives.

This is important for assessing competition in the hospital sector and for anti-trust enforcement. If volume causes quality, then there may be some efficiencies from improved patient outcomes in more concentrated markets. This could also affect hospital merger evaluation. I review three relatively recent studies below that present the strongest evidence to date on the volume-outcome effect : Ho

(2002), Gowrisankaran et al. (2004), and Gaynor et al. (2005). The results of these studies are summarized in Table 4.

Ho (2002) examines the volume outcome relationship for PTCA using data from California hospitals from 1984 to 1996. The outcomes she examines are mortality and emergency CABG. She estimates the effects of hospital cumulative and annual volume on outcomes, employing hospital and time fixed effects. Ho finds substantial improvements in outcomes over time, but a small effect of annual hospital volume on outcome. The effect of cumulative volume on outcomes is imprecisely estimated.

Gowrisankaran et al. (2004) attempt to recover the causal relationship between volume and outcome using instrumental variables. They study the volume-outcome relationship for three surgical procedures : the Whipple procedure (removing tumors from the pancreas) ; CABG ; and repair of abdominal aortic aneurysm (AAA - this repairs weak spots in the abdominal artery). They use data on hospitals from Florida from 1988 to 1999 and California from 1993 to 1997. The instrumental variables approach is to use patient distance from the hospital to estimate patient choice of hospital and then construct predicted volume. Gowrisankaran et al. find that increasing volume causes better outcomes for all three procedures and find significant and large effects of hospital volume on patient mortality. This implies that volume-outcome effects can be important to consider when evaluating the impact of hospital competition.

Gaynor et al. (2005), in a similar paper, use instrumental variables techniques to estimate the volume outcome relationship for CABG. They use data from California for 1983-1999. Gaynor et al. find a causal, and substantial, effect of volume on outcome. For example, if CABGs could only be performed in hospitals with a volume of 200 or greater, the average mortality rate from CABG would fall from 2.5 percent to 2.05 percent, saving 118 (statistical) lives. In a related working paper by the same authors, Seider et al. (2000), simulate the effects of two mergers : a hypothetical "standard merger", in which two out of five firms with equal market shares merge ; and the actual merger of Alta Bates Medical Center and Summit Medical Center in Oakland, California. They find that, for larger hospital mergers (hospital volumes > 140), the value of saved lives from the standard merger outweighs the loss of consumer surplus from increased prices. For the Summit-Alta Bates merger, which does not, however, have a large effect on volume, the effect is a net loss of $2.8 to $4.4 million. The reason is that the increase in volume due to the merger is too small to have much effect on outcomes, while the price increase reduces welfare.

5. Summary and Conclusions

In this paper I have reviewed the literature relevant to competition and quality in health care markets. Economic theory does not provide an unambiguous answer to the question of whether competition is welfare enhancing in markets with product differentiation, although it provides guidance for thinking about the issues. The empirical literature on competition and quality in health care markets is for the most part fairly recent, and growing rapidly. The results from empirical research are not uniform. However, the majority of the studies point to competition leading to increased quality. There are a number of studies that do not point in this direction. In particular, the two studies of price deregulation show quality decreasing in the deregulated environment. Upon reflection this is neither surprising, nor necessarily undesirable. The biggest effect of price deregulation is undoubtedly to increase the price elasticity of demand, which should lead to a large decrease in price, but should also decrease quality. [31] If the regulated price was set at supra-optimal levels then quality was too high under regulation, and the quality decrease following deregulation may be welfare improving.

This first generation of studies has provided a very valuable base of knowledge for further research. The base that has been constructed, while extremely useful, does not allow for clear normative analysis. An important, although formidable task, for future work is to pursue structural approaches to econometric modelling. This means trying to recover preferences and costs. The benefit of this approach is the ability to make clearer inferences about welfare, since estimates of preference and cost parameters are in hand. The drawback is that such estimates are not easily obtained. In particular, they usually can only be obtained at the cost of making untestable assumptions. The quantity, and detail, in health care data may make some of the assumptions employed in settings with sparser data unnecessary, however.

There are three other directions for future studies to pursue. First, measures of health care quality are becoming more common and more sophisticated. Future studies can begin to employ these new measures. Second, most of the studies to date have focused on a single measure of health care quality, and often for a single condition. A task for future work is to try to develop broader evidence on the impact of competition on various aspects of health care quality. Third, the study of the impact of competition on quality should be extended to other parts of the health care sector — most notably physician services and health insurance.

What are the implications for competition policy? The evidence does not suf-

31. For example, the decrease in meal service by airlines. It is plausible that the decreased amount of airline food left passengers better off.

fice to overturn the presumption of competition policy that competition benefits consumers. If anything, the bulk of the evidence indicates that competition in hospital markets leads to increased quality (although I need to continue to point out that this may or may not be welfare increasing).

Market oriented health care system reforms are being considered by quite a few countries. U.S. courts have to make decisions about antitrust issues involving health care firms. Evidence on the impacts of competition on quality in health care is vital to the policy decisions these individuals must make. There is considerable scope for future research to contribute to policy on this issue.

Tableau 1 : *Theoretical Results : Competition and Quality*

Study	Price Fixed or Variable	Type of Product Differentiation	Effect of Competition on Quality	Competitive Quality Relative to Social Optimum
Spence (1975)	Variable	Vertical	+, –, 0	$\lessgtr$
Mussa and Rosen (1978)	Variable	Vertical	+	=
Dranove and Satterthwaite (2000)	Variable	Vertical	+, –, 0	$\lessgtr$
Spence (1976)	Variable	Horizontal	+, –, 0	$\lessgtr$
Dixit and Stiglitz (1977)	Variable	Horizontal	+, –, 0	$\lessgtr$
Mankiw and Whinston (1986)	Variable	Horizontal	+, –, 0	$\lessgtr$
Douglas and Miller (1974)	Fixed	Vertical	+	>
Schmalensee (1977)	Fixed	Vertical	+	>
Vander Weide and Zalkind (1981)	Fixed	Vertical	+	>
White (1972)	Fixed	Vertical	+	>
Held and Pauly (1983)	Fixed	Vertical	+	>
Pope (1989)	Fixed	Vertical	+	>
Allen and Gertler (1991)	Fixed	Vertical	+	>

Tableau 2 : *Health Care Quality and Competition Empirical Studies : Fixed Price*

Study	Time Period	Geographic Area	Medical Condition	Payers	Quality Measure	Competition Measure	Results
Kessler and McClellan (2000)	1985, 1988, 1991, 1994	U.S.	Heart Attack	Medicare	Mortality	HHI	+
Gowrisankaran and Town (2003)	1991-1993 (Heart Attack), 1989-1992 (Pneumonia)	Los Angeles	Heart Attack, Pnemonia	Medicare	Mortality	HHI	–
Tay (2003)	1994	California, Oregon, Washington	Heart Attack	Medicare	Mortality	Demand Elasticity	+
Shortell and Hughes (1988)	1983-1984	45 States	16 Conditions	Medicare	Mortality	N,p	0(N),–(p)
Held and Pauly (1983)	1977-1978	U.S.	Renal Failure	Medicare	Dialysis machines per patient	HHI	–

Tableau 3 : *Health Care Quality and Competition Empirical Studies : Variable Price*

Study	Time Period	Geographic Area	Medical Condition	Payers	Quality Measure	Competition Measure	Results
Joskow (1980)	1976	U.S.	All	All	Excess Bed Capacity	HHI	–
Robinson and Luft (1985)	1972	U.S.	All	All	Admissions, Outpatient Visits, Length of Stay, Average Costs	HHI	–
Dranove et al. (1992)	1983	California	NA	All	High Tech Services	HHI	– (weak)
Noether (1988)	1977-1978	U.S.	11 conditions	All	Expenses (Price)	HHI	–(Expense) +(Price)
Gowrisankaran and Town (2003)	1991-1993 (Heart Attack), 1989-1992 (Pneumonia)	Los Angeles	Heart Attack, Pnemonia	HMO	Mortality	HHI	+
Sohn and Rathouz (2003)	1995	California	PTCA	All	Mortality	Competition Coefficient	–
Propper et al. (2004)	1995-1998	U.K.	Heart Attack	NHS	Mortality	number of competitors	–
Sari (2002)	1991-1997	16 States	All	All	Quality Indicators	HHI	–
Ho and Hamilton (2000)	1992-1995	California	Heart Attack, Stroke	All	Mortality, Readmission	Merger	0 (mortality), + (readmission)
Huckman (2002)	1992-1999	New York	CABG, PTCA	All	Mortality	Acquisition	–
Volpp et al. (2003)	1990-1995	New Jersey	Heart Attack	All	Mortality	Price Deregulation	–
Propper et al. (2003)	1991-1999	U.K.	Heart Attack	NHS	Mortality	Deregulation, number of competitors	–
Abraham et al. (2003)	1990	U.S.	All	All	Quantity consumed	number of hospitals	+

Tableau 4 : *Health Care Quality and Competition Empirical Studies : Volume-Outcome*

Study	Time Period	Geographic Area	Medical Condition	Payers	Quality Measure	Competition Measure	Results
Ho (2002)	1984-1986	California	PTCA	All	Mortality, CABG	Volume-Outcome	+ (small)
Gaynor et al. (2005)	1983-1999	California	CABG	All	Mortality	Volume-Outcome	+
Gowrisankaran et al. (2004)	1993-1997 (CA), 1988-1999 (FL)	California, Florida	Whipple Procedure, CABG, Abdominal Aortic Aneurysm	All	Mortality	Volume-Outcome	+

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